

# The Greening of the Rooftop

## Why Roof Green?

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## Why Roof Green?

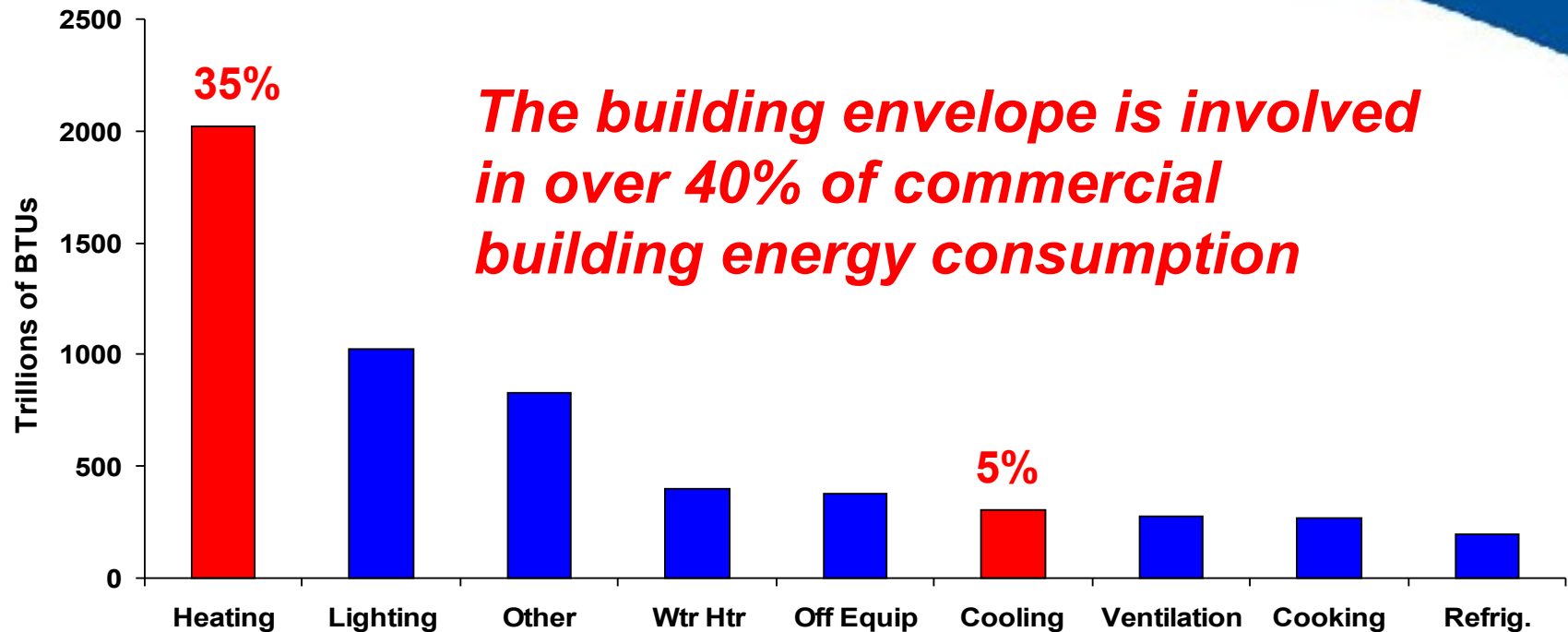
# Meet Critical Energy / Environmental Needs

*No other building element can meet so many energy / environmental needs:*

1. Energy Efficiency
2. Clean Energy Production
3. Low Impact Materials
4. Durability
5. Reuse, Renewal, Recycling



# The Building Envelope Opportunity

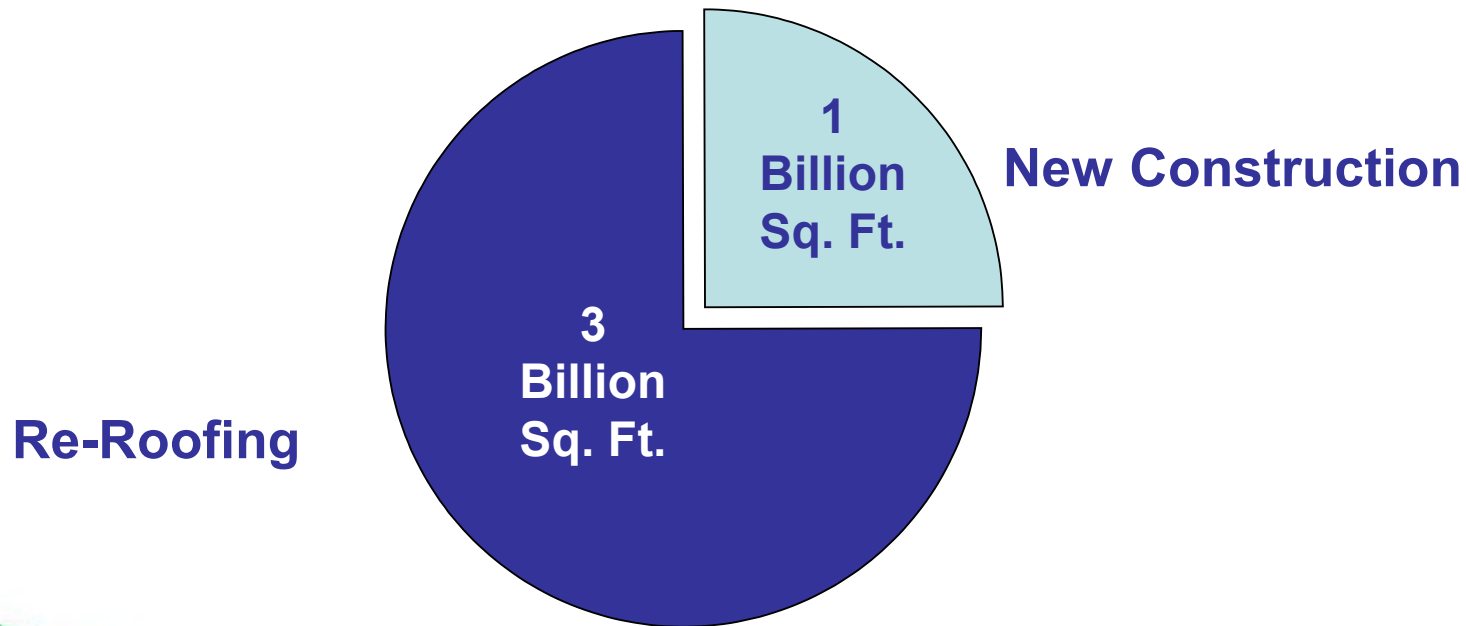


Commercial Building Energy Consumption by End Use



# Low Slope Commercial Roofing

***Each year, commercial roofing exceeds total new construction square footage by 400%***



**North American Low-Slope Roofing Market  
(Billions of Square Feet, 2006)**



# Low Slope Commercial Roofing

Each year...

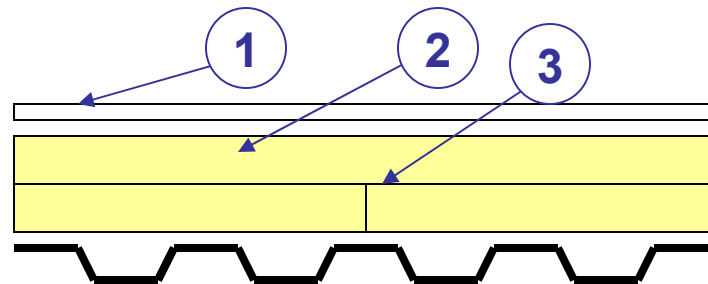
**Four billion square feet** of new low-slope roofs are installed that can be designed and installed to reduce building energy consumption ...

... provided these roofs are designed and installed to accomplish these goals.

# Low Slope Commercial Roofing

## *Multiple Strategies to Save Energy*

- 1 Cool Roof Membranes To Reduce Solar Radiant Loads
- 2 High Efficiency Insulation (R5 to R6 per inch) to Reduce Heat Transfer
- 3 Best Practices such as Multiple Insulation Layers w/ Staggered Joints To Minimize Energy Loss



# Energy Scenarios

- **Base Case: The Present (At Best)**
  - ASHRAE 90.1-1999
  - “Energy Standard for Buildings...”
  - Basic roofing “R” values unchanged since 1973
- **Scenario 1: The Future (Where We’re Going)**
  - ASHRAE 90.1-2007
  - The future standard if/when adopted by building codes
  - 33% average increase in minimum “R” values
- **Scenario 2: An Alternate Future (Where We Should Go)**
  - ASHRAE 189.P (Proposed) “Standard for the Design of High-Performance Green Buildings...”
  - Additional 25% average increase in minimum roof “R” values

# The Energy Efficiency Opportunity

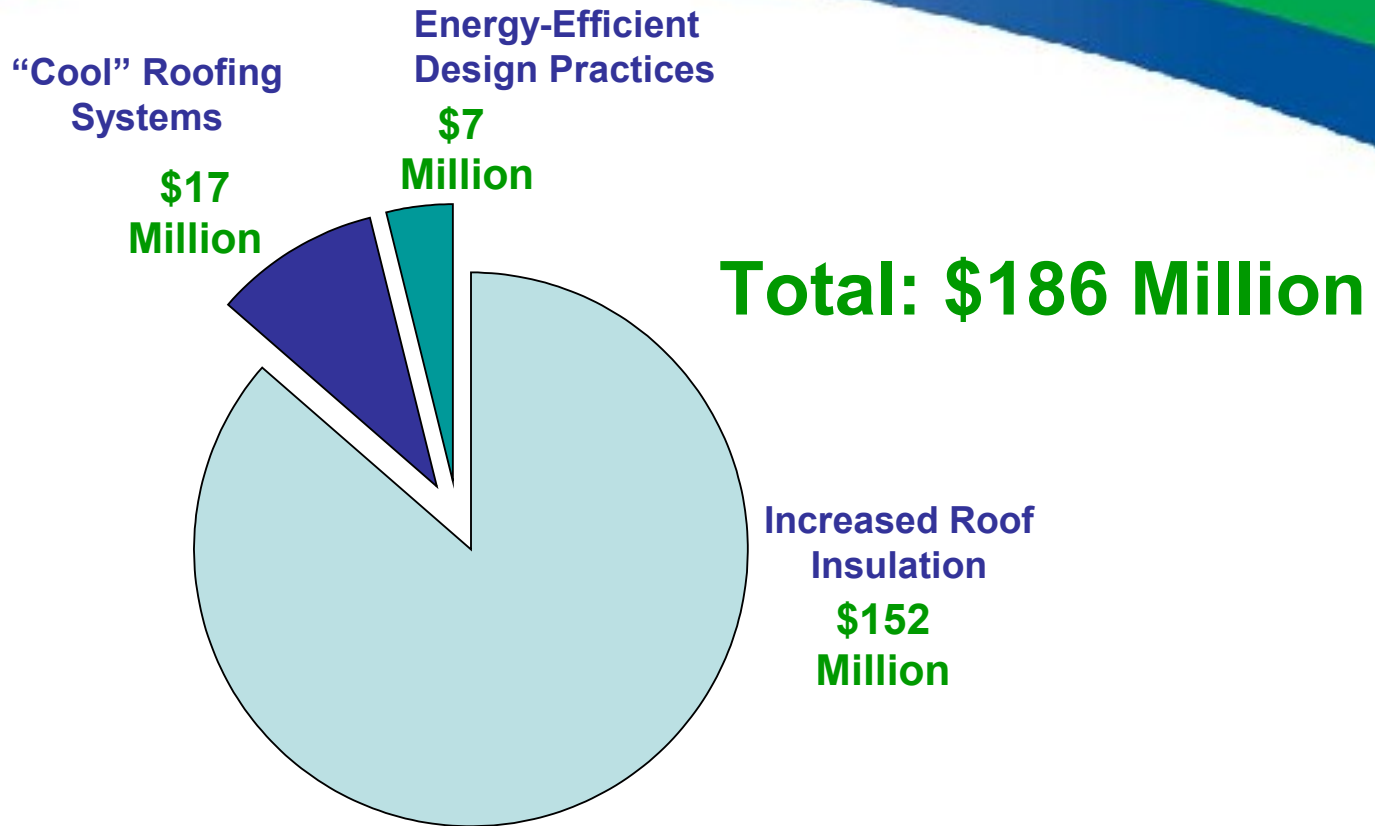
## Energy Scenarios

|                                     | <b>Base Case</b> | <b>Scenario 1</b>                | <b>Scenario 2</b>                |
|-------------------------------------|------------------|----------------------------------|----------------------------------|
| Energy Standard                     | ASHRAE 90.1-99   | ASHRAE 90.1-07                   | ASHRAE 189.P                     |
| Insul. R Value (2)                  | R15              | R20                              | R25                              |
| Cool Roof (3) Usage                 | 25%              | 100%                             | 100%                             |
| Best Practice (4) Usage             | 25%              | 100%                             | 100%                             |
| Gross Heating Cost                  | \$306 Million    | \$233 Million                    | \$192 Million                    |
| Gross Cooling Cost                  | \$119 Million    | \$87 Million                     | \$71 Million                     |
| Cool Roof Adj.                      | (-\$13 Million)  | (-\$36 Million)                  | (-\$30 Million)                  |
| Best Practice Adj.                  | (-\$5 Million)   | (-\$14 Million)                  | (-12 Million)                    |
| Net Energy Cost (1)                 | \$407 Million    | \$270 Million                    | \$221 Million                    |
| <b>Annual Savings v. Base Case:</b> |                  | <b>\$137 Million<br/>(33.7%)</b> | <b>\$186 Million<br/>(45.7%)</b> |

- 1) Annual energy costs based on 4 billion square feet of total annual roof installations, \$0.12 / K WH cooling energy cost, \$1.00 / therm heating energy cost, 2.0 cooling COP, and 75% heating efficiency. Assumes 20% of roofs are replacing existing cool roofs, 5% of roofs are installed over unheated spaces, and 20% of roofs are installed over non-cooled spaces. Calculations derived using the EnergyWise Calculator (<http://www.energywise-specright.net>) for gross heating and cooling costs and the DOE Cool Roof Calculator ([http://www.eere.energy.gov/buildings/energy\\_efficiency/CoolRoofCalculator](http://www.eere.energy.gov/buildings/energy_efficiency/CoolRoofCalculator)) for cool roof energy costs.
- 2) Actual R values vary +/- R5, depending on ASHRAE climatic zone.
- 3) A cool roof is defined as a roof offering 50% long-term solar reflectivity or the thermal equivalent for the service life of the roof.
- 4) Best practices is defined as 2 or more staggered insulation board layers to minimize thermal loss at board joints.



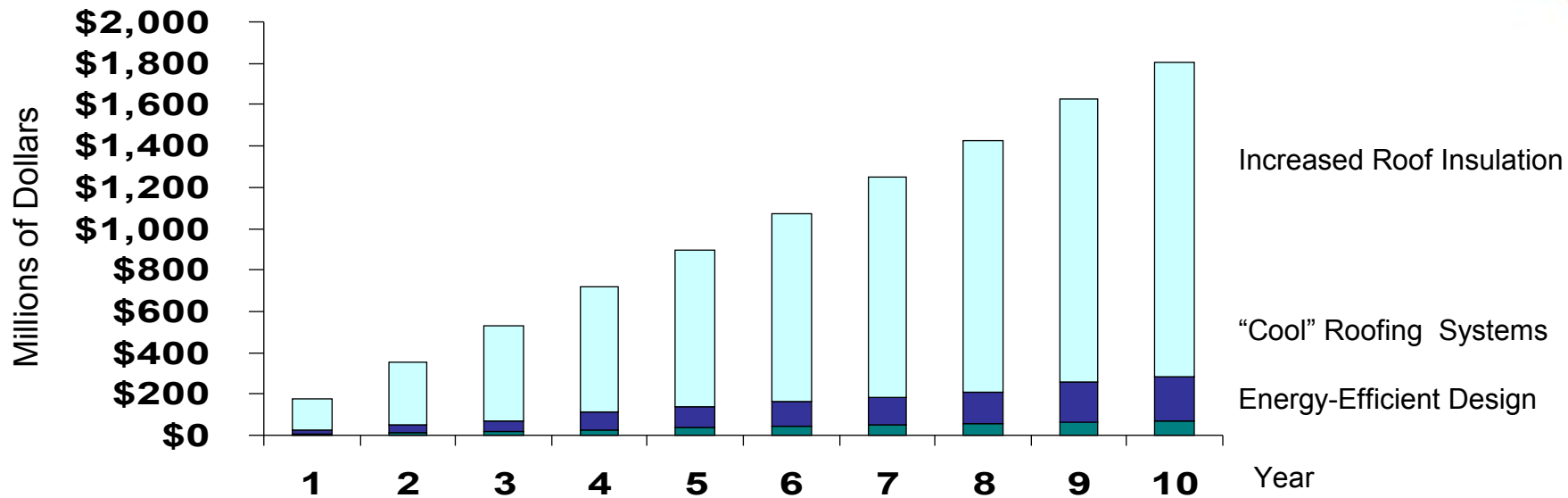
# The Roof Energy Savings Opportunity: Scenario 2: First Year Savings



**First Year Energy Savings:  
4 Billion Sq. Ft. of New Low-Slope Commercial Roofing Installations  
(2008 Dollars)**

# The Roof Energy Savings Opportunity: Scenario 2: Savings after 10 Years

***\$1.8 Billion Annually***  
***\$10+ Billion Cumulatively***



**Annual Energy Savings for  
4 Billion Square Feet of Low-Slope Commercial Roofing Installations  
(2008 Dollars)**

# The Roof Energy Savings Opportunity: Scenario 2: Economic Return

The economic return for increasing the energy efficiency of roofs is very high...

because we have to install these new roofs every year anyway, just to keep up with new construction and normal replacement demand.

# The Roof Energy Savings Opportunity: Scenario 2: Economic Return

|  | <b>Base Case</b> | <b>Scenario 1</b> | <b>Scenario 2</b> |
|--|------------------|-------------------|-------------------|
| Unit Installed Cost (1)                      | \$5.00 / Sq. Ft. | \$5.50 / Sq. Ft.  | \$5.65 / Sq. Ft.  |
| Total First Year Cost<br>(4 Billion Sq. Ft.) | \$20 Billion     | \$22 Billion      | \$22.6 Billion    |
| Incremental Cost                             | _____            | \$2 Billion       | \$2.6 Billion     |
| Net Annual Energy Cost<br>(2008 Dollars)     | \$407 Million    | \$270 Million     | \$221 Million     |
| First Year Savings                           | _____            | \$137 Million     | \$186 Million     |
| 20 Year Savings (2)                          | _____            | \$4.4 Billion     | \$6.8 Billion     |
| <b>Average Annual ROI</b><br>(20 Years)      |                  | <b>11%</b>        | <b>13%</b>        |

(1) Cost data provided from survey conducted by TEGNOS Research, Inc.

(2) Assumes energy costs will increase 6% annually



# Roofing & Energy Producing Energy



# Roofs & Energy Production

## *The Rooftops of the United States:*

**Segment:**

**Surface Area<sup>1</sup>**

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Commercial (Flat)

50 Billion Square Feet

Residential (Steep)

150 Billion Square Feet

**Total**

**200 Billion Square Feet**

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**Energy Potential<sup>2</sup>**

**50,000 Megawatts**  
(10 Grand Coulee Dams)



<sup>1</sup>Derived from Census data

<sup>2</sup>Assumes 1watt average solar power production during daylight hours per square foot of suitable roof surface (225 billion square feet total roof surface X 25% suitable usage factor X 1 watt / square foot)

## Why Green Roofing?

# Meeting Environmental Needs

1. Energy Efficiency
2. Clean Energy Production
3. Low Impact Materials
4. Durability
5. Reuse, Renewal, Recycling

*Roofs meet many environmental needs beyond energy security*



# Green Roofing Options: Meeting Environmental Needs

## Environmental Need:

## Available Strategies:

## Green Roofing Options:

Low Impact Materials

- Reduce Urban Heat Island
- Reduce Storm Water Runoff
- Reduce Urban Ozone
- Extend Life Cycle

- Cool Roofs
- Vegetated (“Green”) Roofs
- Water Retaining Roofs
- Low-VOC Roofing Products
- Highly Durable Roofs

Energy Efficiency /  
Clean Energy

- Reduce HVAC Costs
- Reduce Lighting Costs
- Generate Clean Energy

- Highly Insulated Roofs
- Roof Daylighting
- Photo-Voltaic Roofs

Durability

- Extend Life Cycle

- Highly Durable Roofs

Reuse, Renewal,  
Recycling

- Planned Repair / Renewal
- Material Recycling

- Life Cycle Management
- Roof Recycling Programs